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(54) Description of the item
Device for dusting off wall surfaces, which are at least from time to time impinged upon by a solid-laden gas

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Device for dusting off wall surfaces, which are at least from time to time impinged upon by a solid-laden gas

The invention concerns a device for dusting off wall surfaces in regeneration heat exchangers, dust separators, honeycomb catalyzers and the like, which are at least from time to time impinged upon by a solid-laden gas.

For example, it is known from the DE-PS 36 24 593 to insert blow pipes, which blow into the tubes from the face surface, for dusting off the interior surfaces of a tube-type heat exchanger, through which a processing gas laden with solids is flowing. In the case of regenerative heat exchangers, such as those which are used in conjunction with glass furnaces and where the hot processing gas passes through masonry conduits, which are - purposely or inadvertently - often repeatedly constricted by displacement of the bricks and/or where conduits with a non-circular cross-section are bent, one has been able to manage in the past by having the deposits, which occurred as a result of de-sublimation essentially only in the end region of the conduits, mechanically removed from time to time by workers using poker-like tools. In order to accomplish this the workers have to climb into the masonry of the heat exchanger during the cooling phase, while it is nevertheless still hot, and work overhead under the falling deposits, which represents a highly unreasonable demand on the workers.

Therefore, the invention is based on the objective of creating a dusting off apparatus, which in such and similar cases permits a simpler dusting off process, which furthermore lends itself to being automated.

This objective is achieved to a significant extent by the characteristics of claim 1. The dependent claims indicate advantageous further modifications in this regard.

The blow pipe in question can be, in principle, directed at any desired location where dusting off is desirable, and for this it requires at most only small, easily closed inlet openings.

A plurality of the possible embodiments of the blow pipe described in the dependent claims are suitable for allowing a gas jet to be generated which is particularly suitable for dusting off several kinds of the wall surfaces here under consideration and by keeping in mind the deposits occurring on them.

Below, examples of embodiments are described in more detail on the basis of the figures. The figures show the following:

Fig. 1 a partial vertical section through a regenerative heat exchanger equipped with the related dusting off apparatus,

Fig. 2 a horizontal section through the same regenerative heat exchanger equipped with the related dusting off apparatus in two different planes, where in the upper half of the figure the active masonry, which forms conduits, is visible, and where in the lower half a separating system connected to it can be seen, which allows the introduction of the blow pipe, which is part of the dusting off apparatus,

Fig. 3a and fig. 3b a longitudinal section or a cross-section, respectively, through the end of a blow pipe containing a slot-shaped exit area for the jet,

Fig. 4a and fig. 4b a longitudinal section or a side view, respectively, through the end of the blow pipe with an approximately square area of jet emission,

Fig. 5a and 5b each show a side view of the end of a blow pipe with blow pipe arranged in a bundle from various viewing angles,

Fig. 6 a longitudinal section through the end of a blow pipe with a Laval nozzle disposed at a right angle with respect to the longitudinal axis,

Fig. 7 a longitudinal section through the end of a blow pipe with a Laval nozzle the extension of which is curved with respect to its longitudinal axis,

Fig. 8 a longitudinal section through the end of a blow pipe with an axially disposed Laval nozzle, which terminates in an inclined face surface,

Fig. 9 a longitudinal section through the end of a blow pipe with a Laval nozzle, which is disposed axially and followed by a blade-type jet deflection member,

Fig. 10 a side view of the end of a blow pipe, which is equipped with slide members as guidance means,

Fig. 11a and fig. 11b a side view or a front view, respectively, of the end of a blow pipe with guidance members in the form of rollers disposed on both sides and

Fig. 12a and fig. 12b each a schematic presentation of the end of a blow pipe with a guidance member including a steering system in various phases of the process.

The regenerative heat exchanger 2, partially shown in figures 1 and 2, contains a shaft-like enclosure 4 made of concrete and masonry as well as a heat conserving masonry wall 8, which is enclosed by it and which forms vertical gas flow conduits 6, and which masonry wall is interrupted by a horizontal separation layer 10. While the heat conserving masonry wall 8 is trimmed with specially shaped form bricks 12, which are offset from each other from one layer to the next, the separation layer 10 consists of block-shaped stones 14, which are placed in parallel rows 16 with a horizontal longitudinal axis, so that between the rows 16 horizontally extended conduits 18 are generated. The conduits 18 are flush

with correspondingly dimensioned inlet openings 20 in the enclosure 4 on one side of the heat exchanger 2.

On a rail 22, which can be moved horizontally along the heat exchanger 2 on the side of the openings 20, a drive unit 24 is located, which is mechanically connected to a blow pipe 26, by means of which drive unit the blow pipe 26 can be inserted through any of the openings 20 into the heat exchanger 2, or stated more precisely, into the corresponding conduit 18 itself. The blow pipe 26 is equipped at its end with a nozzle head 28, and at its point of origin, which remains outside the heat exchanger 2, it is equipped with valves 30 and 32 as well as with a compressed air connection 34. Valve 30 is a solenoid valve, while valve 32 is a pressure regulating valve, which under certain conditions may be omitted, but which, on the other hand, if it is needed for cooling purposes, can also allow continuously a certain minimal air stream to pass through the blow pipe 26 by way of passage 35, which bypasses the solenoid valve 30. The compressed air, which is introduced through the compressed air connection 34, comes from an air compressor after first passing through a storage container (not shown).

The rail 22 can be moved into positions along the corresponding side wall 36 of the heat exchanger 2, either manually or, on the other hand, by means of a drive unit, which is not shown, and where the positions always correspond to one of the openings 20. By means of the drive 24 unit the nozzle head 28 must then be brought into any of the desired positions within the conduit of concern 18, which corresponds to one of the conduits 6, in order to dust of so as to clean the corresponding conduit. A horizontally extended slide plate 38 in contact with the side wall 36, which slide plate can be moved horizontally by means of the rail 22, covers all the openings 20, which are not needed at a given time, in order to prevent the entry of unwanted air. In case of need, it is also possible to use individual hinged lids, each of which can be opened and closed, instead of the slide plate 38, which hinged lids are known from the protective covering of electric rails for craneways.

The movements of the blow pipe 26 along with the rail 22 as well as, if so desired, the switching cycles of the solenoid valve 30,, can be automatically controlled, for all of which a control expert will be well acquainted with the appropriate control means.

In figures 3a to 9 different kinds of nozzle heads 28 are shown in conjunction with the blow pipe 26 are shown, which are to be discussed below. In principle, such a nozzle head can not only be provided at the end of the blow pipe 26, but also at different places along the length of the blow pipe, the distance of which depends on the distance of the conduit 6 in the longitudinal direction of the conduits 18, in order to be able to clean several of the conduits 6 at the same time. But it is also equally imaginable to provide several blow pipes 26 for their simultaneous introduction into several conduits 18, in which case these blow pipes 26 are powered and fed individually or, on the other hand, they can be connected to each other mechanically as well as pneumatically.

In the case presented in figures 3a and 3b, the nozzle head 28 consists of a T-shaped pipe section 50, which is connected to the end of the blow pipe 40 and closed on both sides, and in which section 50 a slot 52, which is extended across its entire length, is formed at such a location that a jet emersion 54, which proceeds vertically with respect to the axis of the blow pipe 40, results.

In the embodiment according to figures 4a and 4b, a block-shaped nozzle head 28 emits a hollow jet 60 in the direction of the side of the blow pipe 40, which jet expands slightly toward exterior and has a square cross-section. The wall portion 64 of the nozzle head enclosed by the square nozzle opening 62 is held in place by rung-like wall portions 66.

Instead of a slot-like or square-shaped jet exit the jet exit area can, for example, also have the shape of a hollow cylinder, a hollow cone, a hollow prism or a hollow pyramid or it can constitute a combination of such forms. In all these cases there will be a jet exit area which is adapted to the respective cross-section of the conduits 6 to be cleaned, while it is being assumed that the jet expands in proportion to its distance from the nozzle head 28, to some extent on its own, but also to some extent, however, because of the gas entrained from its environment in the manner of an injector nozzle.

The nozzle head 28 shown in figures 5a and 5b consists, on the other hand, of a T-shaped short pipe section 70, which is connected to the nozzle pipe 40 and which is closed at both its ends, but which contains, in contrast to the pipe section 50 according to figures 3a and 3b instead of the slot 52 a plurality of individual, differently oriented blow pipes 72 with a circular jet exit area 74, which expands slightly toward the outside. The orientation of the blow pipes 72 has been chosen in such a manner, that the jets emanating from it impinge on essentially the entire periphery of each of the conduits 6 to be dusted off.

Figures 6 to 9 show, each in a longitudinal section of the blow pipe end, different embodiments of the nozzle head 28 for generating a jet which is at a supersonic velocity at least at its exit area. Here, the nozzle head 28, in the case shown in fig. 6, is configured as a Laval nozzle 80, which is radial oriented with respect to the axis of the nozzle pipe 40.

According to fig. 7, a Laval nozzle 90, which starts in the direction of the nozzle pipe axis, is curved toward the side inside the nozzle head 28, in order to, once again; produce a jet exit, which is directed radially toward the nozzle pipe exit.

According to fig. 8, a Laval nozzle 100, which is disposed coaxially with respect to the blow pipe axis, terminates in an inclined face surface 102 of the corresponding nozzle head 28, whereby the emitted jet 104 is subjected to a lateral deflection similarly to an optical refraction.

According to fig. 9, a Laval nozzle 110, which is once again disposed coaxially with respect to the blow pipe axis, is followed by a blade-like jet deflection member 114, which forms a jet deflection surface 112, in order to deflect the jet exiting from the Laval nozzle 110 toward the side. As can be seen, the jet deflection member 114 includes two sections 116 and 118, which are placed at an angle relative to each other, the first of which, 116, which runs parallel to the axis of the blow pipe, is attached, for example, by welding to a corresponding recess of the nozzle head 28, while the second, 118, protrudes openly beyond the exit end of the Laval nozzle 110. By means of a reduction 120 in the wall thickness of the jet deflection member 114 at the junction of the sections 116 and 118, the section 118 obtains a certain mobility in the presence of an elastic restoring force, so that it is caused to vibrate by the impinging jet. In this manner the angle of the jet 122, emitted from it, is changed slightly as a function of its frequency of vibration, by which a certain pulsation of the spot of the wall surface to be dusted off, which is impinged upon by the jet is produced, which supports the dusting-off effect.

If required, the section 118 of the jet deflection member 114 which is capable of vibration, or even an entire jet deflection member, can be connected to its own vibrator, which, for example, may be electrically or pneumatically operated. Further, the Laval nozzle, such as for example 90, 100, or 110, may have a flattened or perhaps elliptical cross-section for facilitating the deflection of the jet, while the smaller main cross-sectional axis occurs in the plane of the jet deflection.

In fig. 10, the end of a blow pipe 26 with a nozzle head 28 is shown, which carries for its guidance in the respective conduit 18, toward two sides of the blow pipe, which are perpendicular with respect to each other, guidance members in the form of approximately elliptical slide members 130. The slide members 130, one longitudinal side of which points toward the outside, are located opposite each other, and on the inside they are interrupted and terminate there in a pair of eyes 132. The eyes 132 enclose - preferably with a certain amount of play, in order to give mobility to the slide members 130 - the bolts 134, by which the slide member 130 is attached to the nozzle head 28.

Thus, the nozzle head 28, regardless of the length of the blow pipe 26, is kept at a fixed distance from a wall of the conduit 18, which serves as a guide surface, while the slide members 130 are able to slide across small protrusions 136, of the kind that may occur as a result of distortions of the stones 14 due to thermal expansion.

The figures 11a and 11b show a different embodiment of guide members in the form of rollers 142 of a relatively large diameter, which are positioned on both sides of the nozzle head 28 by means of bearing bolts 140, which rollers are able to move even across somewhat larger protrusions, such as those designated as 144.

The figures 12a and 12b show a still different embodiment of a guide member for the blow pipe 26, by means of which it can be moved across still larger protrusions, as shown in 150.

In this case, a rounded strap 152 and an angle iron 154 are suspended from the nozzle head 28 by means of guide members 156 and 158 or 160, respectively, where the strap 152 and the angle iron 154 share the guide member 156. Stated more precisely, the strap 152

acts upon the free end of the guide member 156, while the angle iron 154 is suspended at the central region of the guide member 156.

As can be seen from fig. 12a, the angle iron 154 protrudes somewhat beyond the strap 152 with regard to the forward movement of the blow pipe with the nozzle head 28 in the direction of the arrow 162. If now the angle iron 154 bumps against the protrusion 150, then the guide member 156 undergoes a change in direction by means of the angle iron, as a result of which the angle iron 154 is lifted with respect to the strap 152 (fig. 12b). Accordingly, the nozzle head 28 is also lifted (arrow 164), while the strap 152 is able to slide across the protrusion 150.

The stops located at the nozzle head 28 for the guide member 156 or the guide member 160, respectively, are identified as 166 and 168

Patent claims:

1. Device for dusting-off wall surfaces in regenerative heat exchangers (2), dust separators, honeycomb catalyzers and the like, which are, at least from time to time, impinged upon by a solids-laden gas, **characterized** in that it includes at least one moveable blow pipe (26), which directs a gas jet against and/or along the wall surfaces.

2. Device according to claim 1, **characterized** in that the blow pipe (26) can be introduced through at least one of the enclosure openings (20) of a heat exchanger (2), dust separator or the like through at least one of its enclosure openings (20).

3. Device according to claim 1 or 2, **characterized** in that in the case of a regenerative heat exchanger (2), in the heat-conserving masonry (8), which forms the gas through-flow conduits (6), a separating layer (10) is interposed for the introduction of the blow pipes, which contains, at the appropriate height, transversely running conduits (18).

4. Device according to one of the preceding claims, **characterized** in that the blow pipe (26) is mechanically moveable and can be directed to its respective point of use.

5. Device according to claim 4, **characterized** in that the movements and, under certain conditions, also the actuation cycles of the blow pipe (26) can be automatically controlled.

6. Device according to one of the preceding claims, **characterized** in that the blow pipe (26), in the region of its free end, contains at least one guide member (130; 142), which is capable of sliding or rolling.

7. Device according to claim 6, **characterized** in that the guide member has a control system which is capable of lifting the blow pipe (26), when it bumps into an obstacle (150), across such an obstacle (figures 12a and 12b).

8. Device according to one of the preceding claims for the dusting off the wall surfaces of gas flow conduits (6) for the processing gas , **characterized** in that at least one jet exit area (54, 60) is located laterally with respect to the blow pipe (26), and that the blow pipe can be moved along the face surface of the gas flow conduits (6).

9. Device according to claim 8, **characterized** in that the jet exit point (54, 60) has a cross-section which has been adapted to the cross-section of the gas flow conduits (6).

10. Device according to claim 9, **characterized** in that the jet exit point (54, 60) has the shape of a slot, a hollow cylinder, a hollow cone, a hollow prism or a hollow pyramid or a combination of such forms.

11. Device according to one of the preceding claims, **characterized** in that the blow pipe (26) has a plurality of blow pipe, which are arranged in the form of bundles (72).

12. Device according to one of the preceding claims, **characterized** in that the blow pipe (26) has means (80; 90; 100; 110) for generating a supersonic jet.

13. Device according to claim 12, **characterized** in that the means for generating the supersonic jet consist in a Laval nozzle (80; 90; 100; 110).

14. Device according to claim 13 in conjunction with claim 8, **characterized** in that the Laval nozzle (90) is curved.

15. Device according to claim 13 in conjunction with claim 8, **characterized** in that the Laval nozzle (100) terminates in an inclined face surface (102).

16. Device according to claim 13 in conjunction with claim 8, **characterized** in that the Laval nozzle (110) is disposed longitudinally in the blow pipe (26) - preferably at the end of the nozzle - and that at the exit point of the Laval nozzle a blade-like jet deflection member (114) is located.

17. Device according to claim 16, **characterized** in that the jet deflection member (114) is capable of being vibrated and is, if required, coupled with a vibrator.

18. Device according to one of the claims 14 to 17, **characterized** in that the Laval nozzle (90; 100; 110) has a flattened, somewhat elliptical cross-section, at least at its exit region, while the smaller main axis of the cross-section is located in the plane of the jet deflection.

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Fig. 1

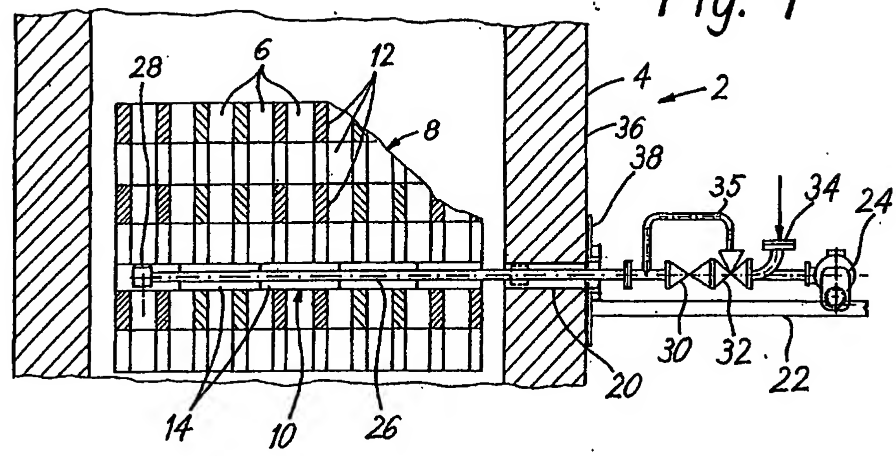

Fig. 2

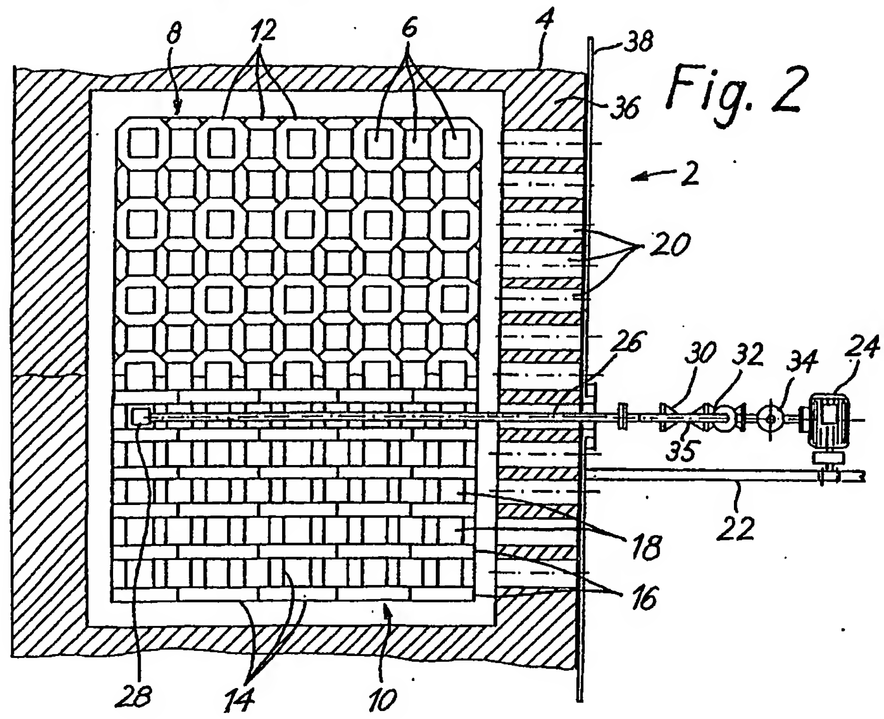

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Fig. 3a

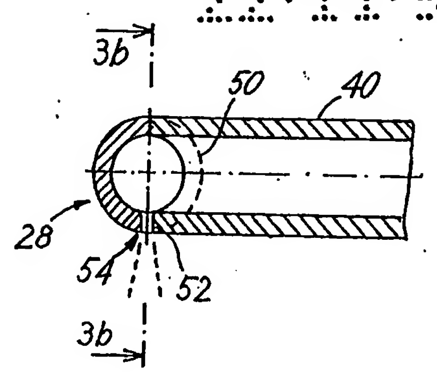


Fig. 3b

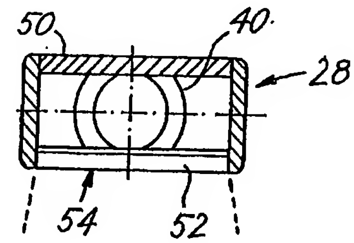


Fig. 4a

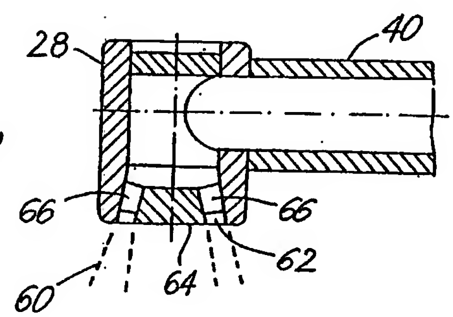
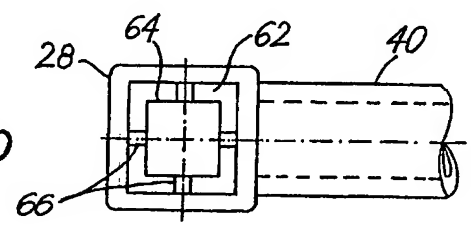


Fig. 4b



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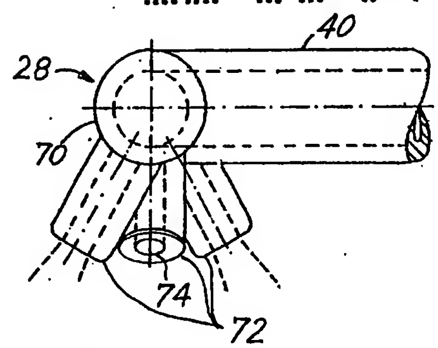

Fig. 5a

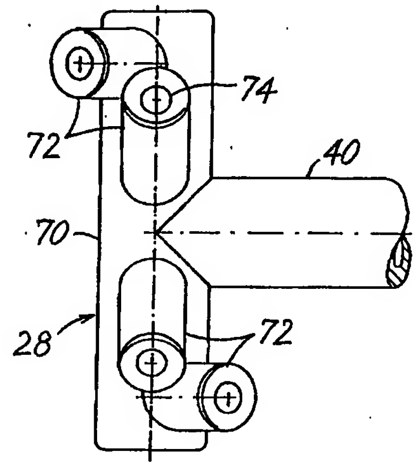

Fig. 5b

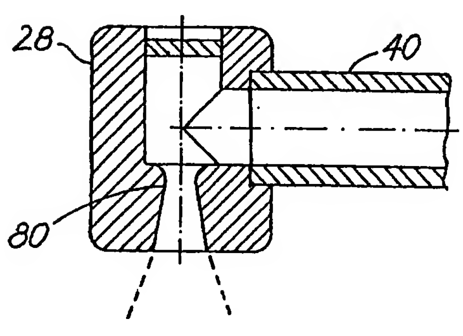

Fig. 6

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Fig. 7

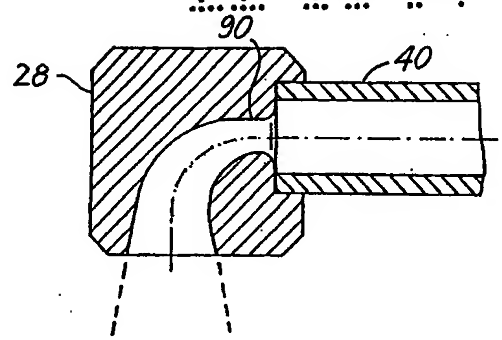


Fig. 8

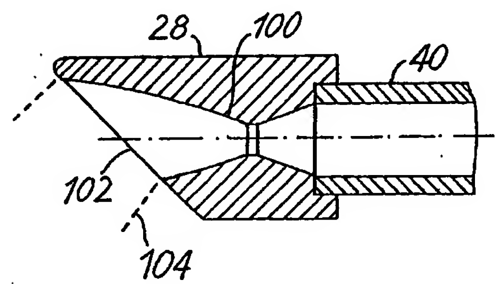
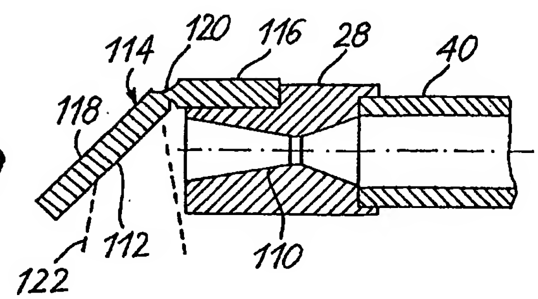


Fig. 9



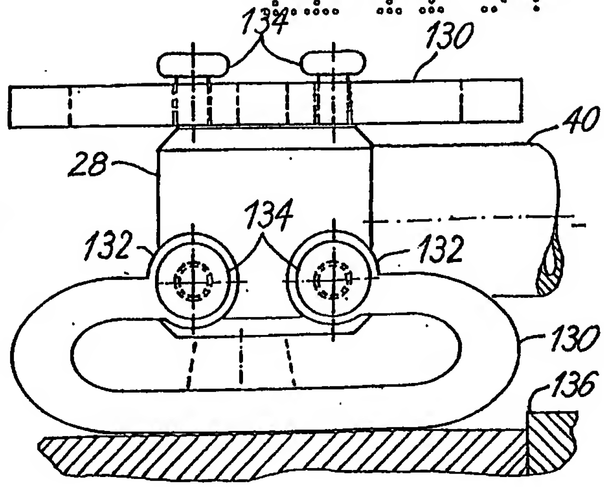


Fig. 10

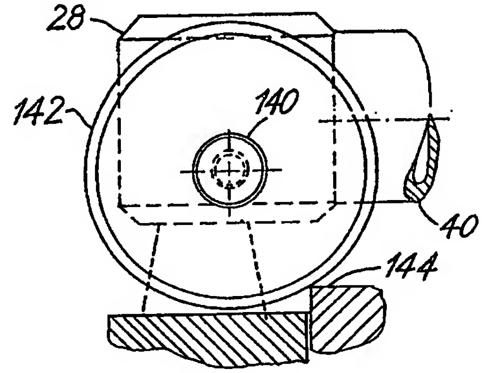


Fig. 11a

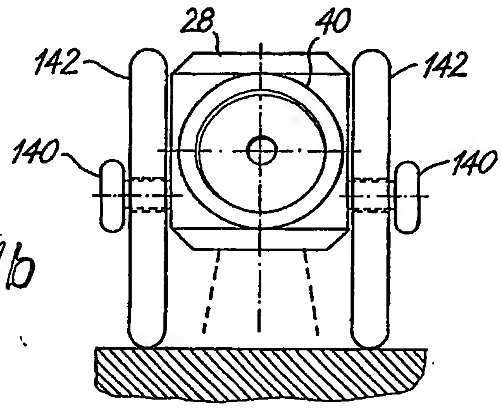


Fig. 11b

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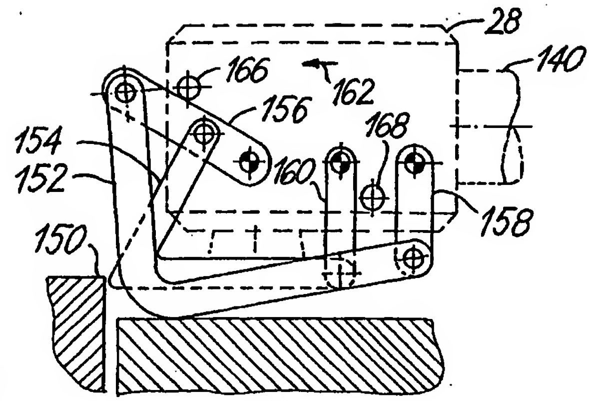

Fig. 12a

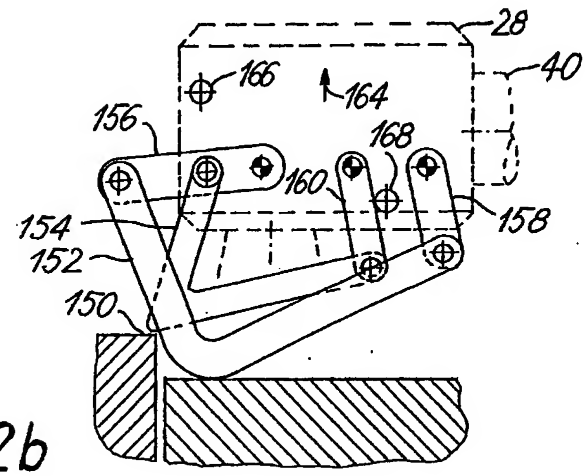

Fig. 12b

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